Maine High School Assessment
Mathematics Augmentation Sample Items

January, 2007

Dear Colleague:

Welcome to this set of sample items. They are presented to provide examples of the types of items that your students will see on the MHSA Mathematics Augmentation (MHSAMA) that will be given to all third-year high school students in Maine during the week of April 23, 2007.

These items are not produced by the College Board. They are adapted MEA released items and items developed by Tad Johnston and Dan Hupp. They are similar to those produced by the College Board, but do not have the same graphical quality. They are not field tested and have not been through the College Board review process. I, Tad, as the final author, take full responsibility for any errors. Please contact me with any that you find.

These items are designed to reflect the range of possible items designed specifically for the MHSA Mathematics Augmentation. They test indicators from the Maine Learning Results that were tested by the MEA, but are not tested by the SAT. These items are probably more difficult on average than items on the augmentation. They are not meant to scare people off. We believe using only easy items would not be fair for those working to prepare for the test. If students can do items like these, they should be well prepared for the MHSAMA. Other sources of sample items would be the samples for SAT Mathematics I Test and the easier sample items (that match the indicators C3, C4, C5, D1, and D2) from AP Statistics. Those items can be found by starting at www.collegeboard.com.

The items for the actual MHSAMA are all produced by the College Board. They are being field-tested with out-of-state students. MHSA item format will be very similar to the SAT item format. All items will be multiple-choice with 5 choices. Like the SAT, there are deductions for wrong answers to reduce the guessing effect.

The directions for the MHSAMA will also be very similar to those for the SAT. The same types of calculators are allowed. The same formulas will be provided. The augmentation will have one or two items involving complex numbers. Students should be able to remember the quadratic formula and use it.

Items that follow are coded to indicators. You'll notice B1 as well (it is not listed in the additional indicators). To achieve needed test characteristics we need some items that require high depth of knowledge. This problem is present in two forms to show non-routine estimation and justification of results.

We did three ATM sessions on the MHSAMA. A video tape of the January 31 session can be requested from the Maine State Library. Contact Alan Fecteau 287-5617 or alan.fecteau@Maine.gov.

Contact us at tad.johnston@Maine.gov 624-6829 or dan.hupp@Maine.gov 624-6827 if you have questions or comments.

The items in this sample are not produced by the College Board.

Directions: For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding circle on the answer sheet. You may use any available space for scratchwork.
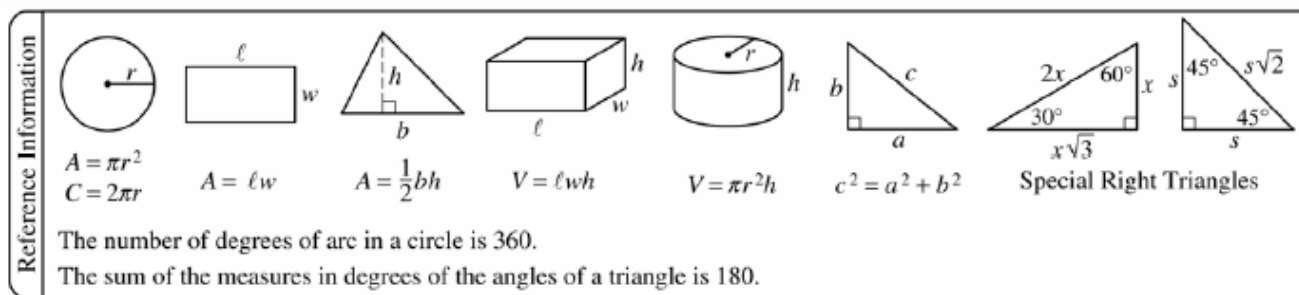
The use of a calculator is permitted.
All numbers are real numbers unless otherwise specified.
Figures that accompany problems in this test are intended to provide information useful in solving the problems.
   They are drawn as accurately as possible EXCEPT when it is stated in a specific problem that the figure is not drawn to scale.
   All figures lie in a plane unless otherwise indicated.
Unless otherwise specified, the domain of any function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number.

Reference Information

$A = \pi r^2$
$C = 2\pi r$
$A = \ell w$
$A = \frac{1}{2}bh$
$V = \ell wh$
$V = \pi r^2 h$
$c^2 = a^2 + b^2$
Special Right Triangles

The number of degrees of arc in a circle is 360.
The sum of the measures in degrees of the angles of a triangle is 180.

Sample Items Cluster One

A2.1
What is the value of the product $(5-i)(5+i)$?
   A) 24
   B) 25
   C) 26
   D) 24 – 10 i
   E) 26 + 10 i

A2.2
Which equation has no real roots?
   A) $x^2 - 3x = 0$
   B) $x^2 + 3x = 0$
   C) $x^2 + 3x = -5$
   D) $x^2 - 3x = -1$
   E) $x^2 - 3x = 15$

B1.1
There are approximately 1,300,000 people in Maine. The average life expectancy is about 80 years. Katie's 17[tt] birthday is May 5, 2007. Which number is the best estimate of how many other Maine people will celebrate their 17th birthdays on May 5, 2007?

   a) about 16,000
   b) about 3,500
   c) about 300
   d) about 200
   e) about 50

B1.2
There are approximately 1,300,000 people in Maine. The average life expectancy is about 80 years. Katie's 17[tt] birthday is May 5, 2007. Which number and explanation provide the best estimate of how many other Maine people will celebrate their 17th birthdays on May 5, 2007?

   a) about 16,000
      1,300,000 people divided by the life expectancy of 80 years
   b) about 3500
      1,300,000 people divided by 365 days in a year
   c) about 300
      1,300,000 people divided by 12 months in a year and 365 days in a year
   d) about 200
      1,300,000 people divided by 365 days in a year divided by 17 years
   e) about 50
      1,300,000 people divided by 365 days in a year divided by life expectancy of 80 years

B2.1

In a modulo 5 system, one counts 0,1,2,3,4,0, 1,2,3,4,0,1,2…..

How would one write the result of 4*4?

A) 0
B) 1
C) 2
D) 3
E) 4

B2.2

An angle has a measure of 50 degrees 45 minutes. What is the measure of an angle three times this size? (1 degree = 60 minutes)

A) 151 degrees 35 minutes
B) 152 degrees 5 minutes
C) 152 degrees 15 minutes
D) 153 degrees 5 minutes
E) 153 degrees 15 minutes

I1.1

Jane is planning to make money by knitting. She plans to knit for no more than 20 hours per week. She has $30 to invest in yarn. It takes three hours to knit a hat and two hours to knit a scarf. Yarn for a hat costs $2 and yarn for a scarf costs $3. She has promised at least 10 pieces (hats or scarves) to the fund raising committee in two weeks.

If H stands for the number of hats and S stands for the number of scarves, which set of equations show the constraints for this situation?

A) $2H + 3S \leq 20$
   $3H + 2S \leq 30$
   $H + S \leq 10$

B) $2H + 3S \leq 30$
   $3H + 2S \leq 20$
   $H + S \geq 10$

C) $2H + 3S \leq 30$
   $3H + 2S \leq 40$
   $H + S \leq 10$

D) $2H + 3S \leq 30$
   $3H + 2S \leq 40$
   $H + S \geq 10$

E) $2H + 3S \leq 20$
   $3H + 2S \leq 40$
   $H + S \leq 10$

I1.2
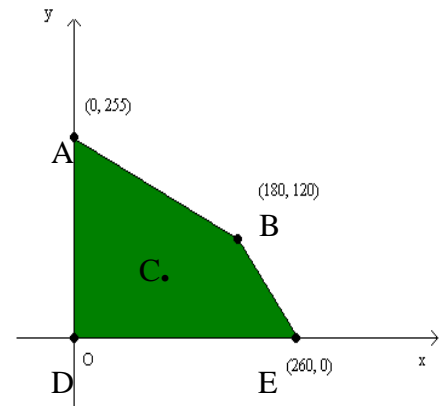
The graph above shows the feasible region for a business situation. The profit formula is written:
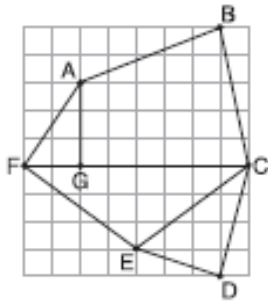
$$P = 2.25x + 0.95y$$

Which point indicates the conditions for maximum profit?

A) A
B) B
C) C
D) D
E) E

Image:
http://aix1.uottawa.ca/~jkhoury/programming_files/image026.gif

The items in this sample are not produced by the College Board.
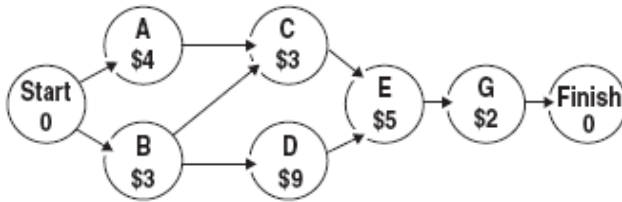
I2.1

In the network above, how many vertices have an odd-number degree?
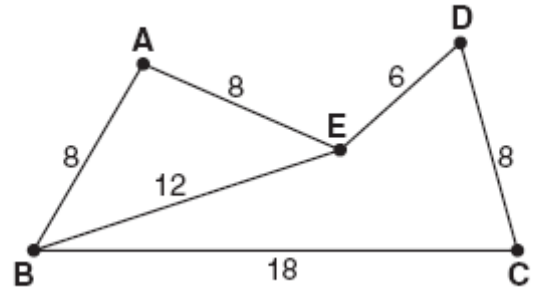
- A) 0
- B) 2
- C) 3
- D) 4
- E) 6

I2.2

13. The chart below shows the routes that may be taken for one trip from start to finish. The circles represent the tollbooths along the way, and the numbers represent the toll charged at each tollbooth.

What is the least amount of toll money required to complete the trip?

- A) $13
- B) $14
- C) $16
- D) $19
- E) $20

I2.3

The map above shows 5 camps and the distance between them in kilometers. The roads between camps are dirt roads. The camp owners want make it possible to drive to every camp on a paved road. What is the minimum length of road they need to pave so every camp can be reached by paved road?

- A) 26 km
- B) 30 km
- C) 44 km
- D) 48 km
- E) 60 km

I4.1

Which value of x makes the following true?

$$\begin{bmatrix} 3 & 2 \\ x & 1 \end{bmatrix} \begin{bmatrix} 2 & 0 \\ -1 & 4 \end{bmatrix} = \begin{bmatrix} 4 & 8 \\ 3 & 4 \end{bmatrix}$$

    A) 0
    B) 1
    C) 2
    D) 3
    E) 4

I4.2

Which matrix system represents the system of equations below?

$$x + y = 8$$
$$3x + 2y = 10$$

A) $\begin{bmatrix} 1 & 1 \\ 3 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 8 \\ 10 \end{bmatrix}$

B) $\begin{bmatrix} x \\ y \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} 8 \\ 10 \end{bmatrix}$

C) $\begin{bmatrix} x & y \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} 8 \\ 10 \end{bmatrix}$

D) $\begin{bmatrix} 0 & 0 \\ 3 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 8 \\ 10 \end{bmatrix}$

E) $\begin{bmatrix} 1 & 3 \\ 1 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 8 \\ 10 \end{bmatrix}$

I4.3

A company has two styles of backpacks in each of two stores. The matrices below represent the price of each style and the number of each style in stock at the two stores.

Backpack styles

|	A	B
Price	[$50	$40]

Stores

	Mall	Main St.
A	20	15
B	30	25

Inventory

If the inventory matrix is multiplied by the price matrix ($[P] \times [I]$), what is the meaning of the result?

    A) the total number of backpacks in each store
    B) the combined value of backpacks in each store
    C) the total value of each style of backpack
    D) the value of each style of backpack in each store
    E) the total number of backpacks of each style

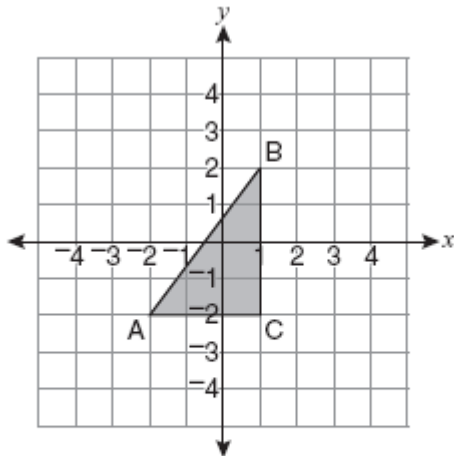The items in this sample are not produced by the College Board.

Sample Items - Cluster Two

E1.1
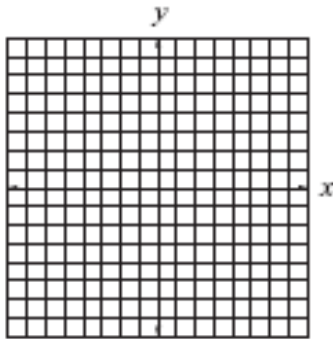
Line ℓ passes through the points (1,1) and
(⁻3,4). Which point is also on line ℓ?

A) (5, -2)
B) (4, -3)
C) (0,2)
D) (-1, 2)
E) (-2, 5)

E1.2

What are the coordinates of the image of point A
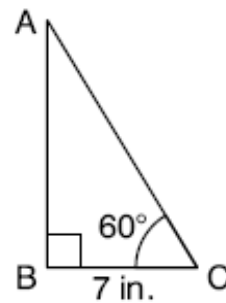after triangle ABC is rotated 90° clockwise around
point C?

A) (-3, -2)
B) (-2, -2)
C) (-2, 1)
D) (1, 1)
E) (1, -5)

E1.3

The point A has coordinates (2, 3). A is
reflected across the line x = ⁻1. What are
the coordinates of the image of point A?

A) (1,2)
B) (1,3)
C) (-4,3)
D) (-2, -3)
E) (2, -5)

E3.1

To the nearest 0.1 inch, what is the length of
$\overline{AB}$?

A)   3.5 in.
B)   7.0 in.
C)   9.9 in.
D) 12.1 in
E) 14.0 in

E3.2

For the larger acute angle in a right
triangle, which has the largest value?

a) sine of the angle
b) cosine of the angle
c) tangent of the angle
d) cotangent of the angle
e) it cannot be determined

The items in this sample are not produced by the College Board.

E3.3

In a stiff breeze, a kite is at the end of 100 meters of kite string. The kite string makes an angle of 35 degrees with the horizontal. About how many meters down range (the horizontal distance) is the kite?

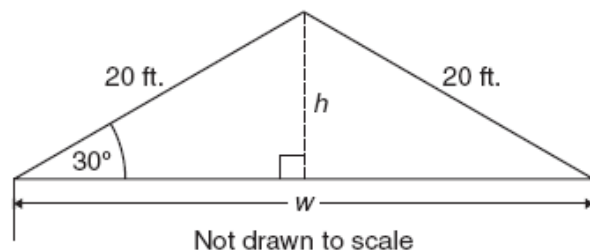| Measure	Sin	Cos	Tan	Cotan
35º	0.574	0.819	0.700	1.428

    A) 55 meters
    B) 65 meters
    C) 70 meters
    D) 80 meters
    E) 140 meters

E3.4

In △ABC shown above, what is sin A equal to?
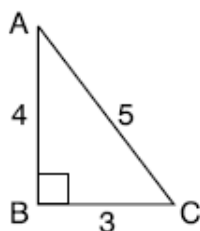
    A) $\dfrac{3}{5}$

    B) $\dfrac{3}{4}$

    C) $\dfrac{4}{5}$

    D) $\dfrac{5}{4}$

    E) $\dfrac{5}{3}$

E3.5

Not drawn to scale

A roof makes a 30° angle with the horizontal floor as shown above. The length of each rafter is 20 feet. What is the width of the floor, w, to the nearest foot?

    A) 10 ft.
    B) 25 ft.
    C) 30 ft.
    D) 35 ft.
    E) 50 ft.

F1.1

Jim reads in an auto manual that a repair should take 1.9 hours. If he starts the job at 11:45, at what time should the repair be completed?

    A) 12:54
    B) 1:15
    C) 1:39
    D) 1:51
    E) 2:15

F1.2

Sara uses a laser sighting device to measure the distance across a lake. The device is accurate to +/- 5 meters. If her device gives a reading of 531 meters, which measure lies outside of the range of expected actual values?

    A) 525 meters
    B) 527 meters
    C) 529 meters
    D) 530 meters
    E) 535 meters

F1.3

Diana's yard is listed as being 120 feet by 80 feet. Her real estate agent tells her that the measures are rounded to the nearest foot. What is the difference between the minimum and maximum possible areas of her yard (rounded to the nearest square foot)?

    A) 50 square feet
    B) 100 square feet
    C) 150 square feet
    D) 200 square feet
    E) 400 square feet

F1.4

Pressure is described as force per unit area. Which units below could be used to measure pressure?

    A) foot-pounds
    B) pounds/square inch
    C) grams/cubic centimeter
    D) Newton-meters
    E) meter/Newtons

Sample Items Cluster 3

C3.1
A set of data has a mean of 200 and a standard deviation of 10. If each element of the data set is increased by 5, which statement is true?

A) The mean will increase, but the standard deviation will stay the same.
B) The mean will increase, and the standard deviation will increase.
C) The mean will increase, but the standard deviation will decrease.
D) The mean will stay the same, but the standard deviation will increase.
E) The median will increase, but the standard deviation and mean will stay the same.

C3.2
Factors A and B are strongly negatively correlated. This could be the result of

I. a decrease in A causing a decrease in B
II. an increase in B causing a decrease in A
III. an outside factor C causing a decrease in A when C causes an increase in B

A) I only
B) II only
C) I or II
D) II or III
E) I, II, or III

C3.3
Factors A and B are strongly positively correlated. What is the most likely slope of the line of best fit for a scatter plot showing the relationship between A and B?

A) 1.5
B) 1.0
C) 0.8
D) 0.2
E) It cannot be determined which is the most likely slope.

C4.1
A member of the city council wants to find out the public opinion in her city about a proposed new sports arena. Which sampling method is random?

A) giving the survey to every 25th person listed on the city census
B) giving the survey to 20 people suggested by each city council member
C) giving the survey to every fifth person who buys tickets at the old sports arena
D) giving the survey to every 10th person who comes into town hall
E) None of the methods is random.

The items in this sample are not produced by the College Board.

C5.1
Beth was doing a population study of salamanders in Crooked Stream. Every 10 meters she put down a square 0.25 meters on a side and then counted the salamanders that she found in the square. She totaled her data and used the mode of the number of salamanders she counted at a site to predict the salamander population of Crooked Stream. What should be suggested to Beth to improve her study?
   A) use random rather than regular sampling
   B) use the mean as the measure of central tendency
   C) use a circle rather than a square to set the sample region
   D) A and B
   E) B and C

D1.1
John flips three coins together. What is the probability that all three coins match?
   A) 1/8
   B) 1/6
   C) 1/4
   D) 1/3
   E) 1/2

D1.2
John has 3 pairs of blue socks and 2 pairs of brown socks. The socks are just out of the dryer (not paired together). If he pulls two socks out without looking, what is the probability that they are both blue?
   A) 1/6
   B) 1/5
   C) 1/4
   D) 1/3
   E) 9/25

D1.3
In a class of 20 students, 12 students play soccer. Ten students in the class are boys. If a student is chosen at random from the class, what is the probability that the student is a boy who plays soccer?
   A) 22%
   B) 30%
   C) 44%
   D) 83%
   E) It cannot be determined from the information given.

D2.1
Students at a local high school completed a survey about the amount of money they spend on snacks during the week. The results are shown in the following table.

Money Spent on Snacks During the Week					
	$0–$4.99	$5–$9.99	$10–$14.99	$15 or more	TOTAL
Girls	80	60	10	0	150
Boys	10	25	60	5	100
TOTAL	90	85	70	5	250

If one of these students is selected at random, what is the probability that the student spends $10 or more for snacks during the week?
   A) 22%
   B) 24%
   C) 26%
   D) 28%
   E) 30%

D2.2

Diagram from http://www.managers-net.com/frequencydistribution.html
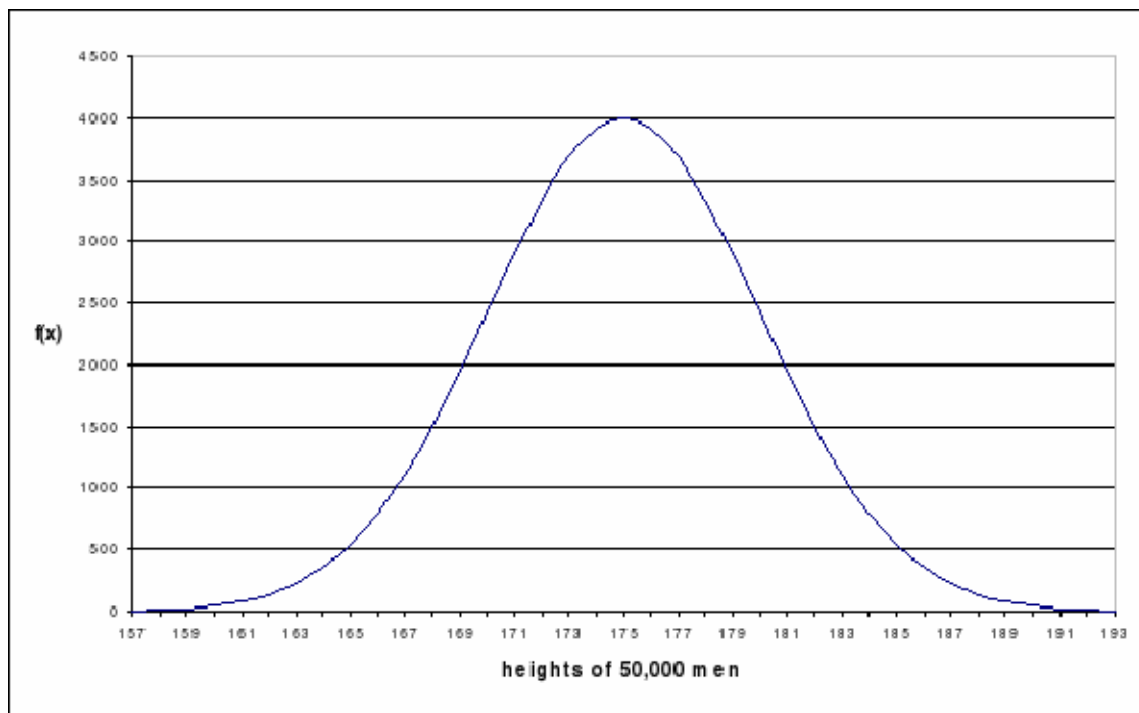
The graph above shows the distribution of heights for 50,000 men. The horizontal axis is marked in cm and the vertical axis is the number at each height. The graph has been smoothed. The mean height of the group is 175 cm and the standard deviation is 5 cm. In what range do approximately 2/3 of the men's heights lie?

    A) 150 cm to 175 cm
    B) 160 cm to 175 cm
    C) 170 cm to 180 cm
    D) 170 cm to 185 cm
    E) 175 cm to 191 cm

J1.1
Two of the measures of central tendency, mean and median can be called an "average" for a set of data. For which of the following pairs of data sets could a different conclusion be drawn as to which has the larger "average" depending on "average" one chooses?

	Set A	Set B
A)	5, 7, 7, 8, 10	6, 8, 8, 9, 11
B)	6, 8, 8, 8, 10	4, 8, 8, 8, 12
C)	5, 8, 8, 9, 10	6, 7, 7, 10, 12
D)	5, 8, 8, 8, 11	6, 7, 7, 7, 8
E)	1, 2, 3, 4, 5	6, 7, 8, 9, 10

The items in this sample are not produced by the College Board.

Sample Items Key

A2.1 C
A2.2 C
B1.1 E
B1.2 E
B2.1 B
B2.2 C
I1.1 D
I1.2 E
I2.1 D
I2.2 A
I2.3 B
I4.1 C
I4.2 A
I4.3 B

E1.1 A
E1.2 D
E1.3 C
E3.1 D
E3.2 C
E3.3 D
E3.4 A
E3.5 D
F1.1 C
F1.2 A
F1.3 D
F1.4 B

C3.1 A
C3.2 D
C3.3 E
C4.1 E
C5.1 D
D1.1 C
D1.2 D
D1.3 E
D2.1 E
D2.2 C
J1.1 C

The items in this sample are not produced by the College Board.